

ARGONNE NATIONAL LABORATORY

INTRA-LABORATORY MEMO



Advanced Photon Source

July 22, 2004

To: R. Gerig Director ASD
From: J. Lang ASD Adm.
Subject: **Report on the LEUTL Radiation Stop**

Background

On the evening of July 8, and during the day on July 9, 2004, machine physicists working with the APS injector machines were attempting to transport electrons to the low energy undulator test line (LEUTL). They were unable to transport beam beyond the location of an ACIS-controlled radiation stop located in the booster alcove, immediately upstream of the penetration into the LEUTL shielded enclosure. An access into the booster enclosure took place during the afternoon of July 9 to try to determine the state of this radiation stop. The inspection indicated that an improper cylinder assembly was installed by ASD-Vac during the May 2004 shutdown and that the ACIS connections to the LEUTL Radiation Stop were also improperly installed.

On identification of the Rad Stop issue the machines were placed in a safe configuration. The two booster bypass vertical "pitch" magnets were locked out. The LEUTL was left in beam permit mode, assuring that no personnel can be near the area near the misconfigured radiation stop. Scheduled machine studies associated with LEUTL were cancelled.

The ASD ESH/QA Manager informed ANL Management and the DOE APS Representative of the incident and subsequently submitted a DOE Occurrence Report.

Description of Incident

Following the 2BM issue in July 2002 ASD-Vac began redesigning the beam stop cylinder assemblies to address a recommendation in the 2BM report to eliminate the possibilities of improperly connected pneumatic lines. The design of the cylinders underwent review specifically for their application on new beamline front ends. Meetings were held between Vac and SI to discuss the proposed design changes. Drawings of the assembly were given to XFE. The final design incorporated changes to prevent the assembly from being mounted incorrectly. The cylinder design was applicable for use in the Triple and Double beam stops where the cylinder assemblies

are located above the beam line. The ASD-Vac engineer who redesigned the assemblies did not apparently realize that the LEUTL radiation stop cylinder assembly is located below the beamline.

The redesigned assemblies were installed in the double and triple beam stops during the September 2003 shutdown. (Note: The final design review for the IXS -CDT and Nano-CDT Front End Components took place in February of 2004.) Work was scheduled to install the LEUTL radiation stop assembly during the December 2003 Shutdown. Scheduling conflicts resulted in the work being postponed until the May 2004 shutdown.

ASD Vac installed the cylinder assembly during the May 2004 shutdown. It was not apparent to the technicians performing the work that the newly designed cylinder they were installing was inappropriate for the application intended at the LEUTL radiation stop. Later a SI engineer connected the assembly to ACIS. He noted discrepancies in the validation of the radiation stop. He states that prior to working on the assembly, when conversing with the Vac techs who installed the cylinder assembly they had mentioned that it was reversed or backwards. (Note the Vac techs don't recall this but stated that they don't recall the exact conversation.) The fact that the cylinder was located beneath the beamline and his interpretation of the location of the stop when actuated, lead him to believe (incorrectly) that the stop was in the beam line when in the raised position. He wired the stop accordingly. The actual ACIS validation of the stop was not performed immediately following the installation and wiring. The validation was performed as part of a larger validation later in the shutdown. The normal validation process was not robust enough to identify the improper cylinder assembly or the improper connection of the ACIS feeds.

On the morning of July 8th 2004, Ops removed the locks from the pitching magnets and PFS racked in the switchgear. LEUTL was placed in "Beam Permit" mode in preparation for LEUTL studies later that day. The improperly configured cylinder was discovered when the physicists were unable to get beam into the LEUTL. Following an examination of the radiation stop, LEUTL was placed in "Beam Permit" mode to eliminate access to the LEUTL and the pitching magnets were locked out and switchgear was racked out.

The LEUTL radiation stop is a single radiation stop just downstream of the second vertical bend (pitch-level) magnet. This stop is provided to shield the LEUTL tunnel from radiation created by a nearby beam impact in case the first vertical bend (pitch-up) magnet fails to be disabled by the ACIS. Thus if one of the two critical devices (the two vertical pitching magnets) fails to be disabled, the stop will still provide protection in the LEUTL tunnel. The power supplies for the pitching magnets are locked out by Ops and the switchgear is racked out by PFS when the LEUTL is in authorized access. Occupants of the LEUTL tunnel are protected from radiation entering the tunnel from

synchrotron operation by the collimating effect of the shield walls through which the Linac-to-LEUTL electron beam must pass. Additionally a radiation monitor is located at the upstream shield wall in the LEUTL Tunnel. The monitor is set to alarm at 8mR/hr and trip the LINAC at 10mR/hr. This device is an ALARA measure as a backup to the structural shielding provided by the facility configuration.

Observations Made During the Interviews

- ASD-Vac designed new cylinders to address issues noted in the investigation of the 2BM incident. Vac. placed an order for several identical cylinders. However in the case of the cylinder for the LEUTL radiation stop that is mounted beneath the beam line, the actuation requirement is different than the other stops. This was not recognized when designing/procuring the cylinders. The cylinders were not appropriate for the application intended at the LEUTL radiation stop.
- The design reviews of the new cylinder assembly design did not consider the applicability of the assemblies for the LEUTL radiation stop configuration.
- ASD-Vac had replaced 5 cylinders during the September 2003 shutdown. (Triple and double-stop). An ASD engineer had been present through most of these change outs and had supervised the technician work and checked the adequacy of the work on completion of the swap out. This is the same engineer who designed/procured the new cylinders.
- ASD-Vac had scheduled the swap out of the LEUTL radiation stop for the Jan. 2004 shutdown but ASD-SI was unable to schedule their part of the work for that period so the job was rescheduled for the May 2004 Shutdown.
- The ASD-Vac techs that swapped the LEUTL stop were the same techs that had swapped the other stops. The techs were comfortable with the work planning that went into the previous installations. With this in mind and taking into account the amount of supervision offered the techs on the previous work, the engineer opted to allow the techs to perform the work themselves with limited supervision. He did not examine the work area before the work and did not note that the cylinder was not configured to work properly in the reversed mounting required at the LEUTL.
- At no time were drawings of the stops requested or made available to the technicians performing the swap out. The depth of supervision on the previous stops may have precluded the need for drawings at the work site. For the LEUTL radiation stop, drawings would have been crucial for identifying the "reversed" operation of the cylinder to be installed.
- The ASD-SI engineer who wired the radiation stop to ACIS was unclear about the actual position of the beam stop when activated. He thought it was in the beam when extended.
- The ASD-SI engineer who improperly wired the radiation stop did so to achieve the ACIS response he was expecting.

- The ASD-ADD-ES and the ASD-IS group leader believe at this time that the only way that ACIS could have been “made up” to recognize the improper position of the cylinder as “correct” would have been that ACIS had been incorrectly wired by ACIS personnel at the time of the swap.
- The LEUTL radiation stop was not validated at the time of the work but later in the shutdown as part of a broader validation.
- The ASD-ADD-ES and the ASD-IS group leader stated that there might presently be no complete electrical drawings for the LEUTL radiation stop.
- During the September 2003 shutdown the ASD-Vac technicians and engineer responsible for installing the cylinders on the triple stop reported that ASD-SI had difficulties making up the ACIS. SI had contacted the Vac. engineer who went to the work site and pointed out that the installation was correct. The problem was not with the Vac. installation process. SI did not contact Vac again about the issue.
- The ASD-Vac technicians responsible for installing the cylinders felt that there was a lack of communication between SI and Vac. When the cylinders were first installed the techs felt that SI did not understand the scope of the work performed by Vac or that required by SI.
- The LEUTL radiation stop does not allow for clear indication of the position of the stop. There is a small view port but it is not adequate for proper verification of the location of the stop. The Vac techs interpreted what they saw as proper alignment.
- Interviews with the ASD ADD-ES and the ASD-SI group leader indicated that they believed the AOD Chief of Operations for the injector facilities had the responsibility for coordinating work including that on critical components. Essentially the role of the “front ends Critical Components System Manager’s new responsibilities mirrored that of a Chief of Operations.. The CO had no knowledge of this responsibility and at no time oversaw or coordinated work on the radiation stop. In a maintenance period, one of a CO’s primary roles is to coordinate access to the accelerator tunnels.

The ASD ESH Administrator met with the following individuals during the evaluation of this incident:

List of Interviewees:

(Omitted)

Recommendations:

- 1 The APS should stand down on work on Critical Components until APS Management meets with all applicable personnel to instruct them on the importance of planning and working within their defined scope of work on critical components. (DONE)
- 2 The ASD-Division Director should initiate an audit in 90 days to verify that the recommendations applicable to ASD identified in the August 2002 Davey/Lang and the July 2003 Noonan reports to management regarding the July 2002 2BM issue have been addressed and completed. (DONE)
- 3 For future work on critical components the groups involved should collectively prepare a work plan such as a JSA defining the scope of work of each group and identifying responsible individuals for each task.
- 4 Clear verification of the required functionality of Critical Components must be present at the device.
- 5 Clear verification of the required functionality for the associated hardware must be established for all ACIS/PSS validation steps.